

DISTRIBUTION AND TAXONOMY OF *SYMPHYOTRICHUM SERICEUM*
AND *S. PRATENSE* (ASTERACEAE: ASTEREA)

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ABSTRACT

Symphotrichum sericeum and *S. pratense* are distinct, non-intergrading species primarily of the central U.S.A., sympatric only in Texas. The densest distribution of *S. sericeum* is in north-central states, with disjunct populations and population systems extending southward to Arkansas, Oklahoma, and Texas. The densest distribution of *S. pratense* is in Texas, southern Arkansas, and Louisiana, with disjuncts extending to Alabama, Florida, Georgia, Kentucky, Mississippi, Tennessee, and Virginia, with an historical record from North Carolina. Specimens from these disjunct sites in the southeastern U.S., some of which are still being listed as *S. sericeum* on state checklists and rare species reports, are here treated as *S. pratense*. *Symphotrichum sericeum* consists largely of diploid populations, while both tetraploid and diploid populations occur in *S. pratense*. County-level distributions of both species are mapped. *Symphotrichum sericeum* is state-listed in 4 states and *S. pratense* in 7 states.

RESUMEN

Symphotrichum sericeum y *S. pratense* son especies distintas, que no se intergradan, primariamente del centro de U.S.A., simpátricas sólo en Texas. La distribución más densa de *S. sericeum* está en los estados del centro-norte, con poblaciones disyuntas y sistemas de poblaciones que se extienden hacia el sur hasta Arkansas, Oklahoma, y Texas. La distribución más densa de *S. pratense* está en Texas, sur de Arkansas, y Louisiana, con disyunciones que se extienden hasta Alabama, Florida, Georgia, Kentucky, Mississippi, Tennessee, y Virginia, con una cita histórica de North Carolina. Especímenes de estas disyunciones en el sudeste de U.S., algunos de los cuales aún se listan como *S. sericeum* en listados estatales y citas de especies raras, se tratan aquí como *S. pratense*. *Symphotrichum sericeum* consiste mayormente en poblaciones diploides, mientras que en *S. pratense* se encuentran tanto poblaciones tetraploides y diploides. Se aportan mapas de distribución a nivel de condado de ambas especies. *Symphotrichum sericeum* está en las listas estatales de cuatro estados y *S. pratense* en 7.

Symphotrichum sericeum (Vent.) Nesom and *S. pratense* (Raf.) Nesom are two closely related taxa of central and eastern United States. In most treatments they have been maintained as distinct species (e.g., Correll & Johnston 1970, Cronquist 1980, Jones 1990, Nesom 1994, Brouillet et al. 2006). When the taxa are considered to be conspecific (see Wunderlin & Hansen 2004), *S. pratense* is treated as *S. sericeum* var. *microphyllum* (DC.) Wunderlin & B.F. Hansen. *Symphotrichum pratense* was known for many years as *Aster phyllolepis* Torr. & A. Gray. *Symphotrichum sericeum* is generally distributed in the central states, from Texas to North Dakota and southern Canada, to western Michigan. *Symphotrichum pratense* is largely concentrated in eastern Texas and western Louisiana. Populations of plants in this complex that are disjunct further eastward—to Florida, Virginia, and Kentucky—are somewhat intermediate in phyllary morphology and have been variously treated as *S. sericeum*, *S. pratense*, or *S. sericeum* var. *microphyllus*, and a number of states treat these often widely scattered populations as state-rarities. Chromosome counts also need clarification, as both ploidy levels ($2n = 10$ and $2n = 20$) have been published for both taxa (Brouillet et al. 2006). The objective of this paper is to update available information on this complex, clarify geographical distributions, point out distinguishing features, identify typical habitats and associates, review available chromosome information, and summarize the state-rarity status of the taxa.

The present study provides a detailed view of the geographic distribution of *Symphyotrichum sericeum* and *S. pratense*, based primarily on a study of herbarium specimens from BRIT-SMU, EKY, GA, LSU, MO, NCU, NLU, TENN, TEX-LL, UNC, VDB, and VPI. Maps are augmented by records from various published sources. The available literature on habitats, associates, and chromosome numbers was also reviewed. A new chromosome report from a Kentucky population is based on mitotic counts from root tip squashes from germinating achenes. The key is based on a detailed examination of morphological characteristics of herbarium specimens from across the ranges of the two taxa.

SYMPHYOTRICHUM SERICEUM

Distribution and Habitat.—The primary distribution of *Symphyotrichum sericeum* is from Arkansas and Oklahoma to southern Canada to western Michigan and Indiana, with disjunct populations in central Texas (Fig. 1). Over the larger part of its range, *S. sericeum* occurs in a variety of habitats, e.g., dunes, sandy woods, glades, sandstone glades, over granite outcrop—but typically associated with seasonally dry, open to semi-open habitat. *Symphyotrichum sericeum* in Texas mostly occurs on the Edwards Plateau, where it grows on limestone hills, commonly on open, rocky slopes and roadbanks. An early collection supposedly made far to the east (**Harris Co.:** Lindheimer 78, BRIT) is similar in every respect to Edwards Plateau plants and may be mislabeled. Swink and Wilhelm (1994) list a number of associates of this species in Illinois, including *Amorpha canescens*, *Schizachyrium scoparium*, and *Bouteloua curtipendula* in dry hill prairies, and *Anemone cylindrica*, *Liatris aspera*, *Liatris cylindracea*, and *Spiranthes cernua* in sand barrens sites near Lake Michigan. In Wisconsin it occurs at dry prairie sites on hillsides, outcrops, and bluffs, sometimes under oaks, jack pine, or red cedar, but usually in the open in habitats dominated by *Schizachyrium scoparium*, with *Asclepias viridiflora*, *Dalea purpurea*, and *Brickellia eupatorioides* (Cochrane & Iltis 2000). In Manitoba the species occurs in remnant tall-grass prairie sites and in openings in *Quercus macrocarpa*/*Populus tremuloides* woodlands (Foster & Hamel 2006).

The species is primarily associated with the Central Lowlands Physiographic Province in the U.S., but it also occurs in the Ozark Plateau Province of Arkansas and Missouri. A recent collection of *Symphyotrichum sericeum* from open shale barrens on a southwest-facing slope in central Arkansas, is apparently the first record from the Ouachita Mountains Province. This site is disjunct from the nearest populations about 155 km to the northeast on the Ozark Plateau. Voucher: **Garland Co.:** Ouachita Mountains, Ouachita National Forest, steep S-facing shale barrens (Mazarn Formation) on upper slope, east of and above Walnut Creek near point at which it flows into Lake Ouachita, Crystal Springs 7.5' quadrangle, steep glades, elev. 750 ft, hundreds of plants in high quality shale barrens, 29 Sep 2006, Witsell 06-471 (ANHC, BRIT, UARK). A second population was subsequently found in similar habitat 1.9 km northwest of the above site.

Chromosome Numbers.—There are about a dozen published diploid counts for *Symphyotrichum sericeum*, these mostly from the northern portions of its range (Jones 1980; Semple & Brouillet 1980; Semple & Chmielewski 1987; Semple et al. 1989; Semple et al. 2002), with the most southerly count from IZARD Co., Arkansas (Sherif et al. 1983). There is apparently only a single report of a tetraploid count (Löve 1982) for *S. sericeum*, this count from Canada; there are also diploid counts from this same vicinity (J. Semple, pers. comm.).

Taxonomy.—Brouillet et al. (2006) treated *Symphyotrichum lucayanum* (Britt.) Nesom as a synonym of *S. sericeum*, but *S. lucayanum* is here considered to be more closely related to *S. concolor* (L.) Nesom, based on their similarities in capitulescence and phyllary morphology and their closer geographical proximity. The latter is widespread in the southeastern U.S.A. *Symphyotrichum lucayanum* was treated by Nesom (1994) as a distinct species, based on its very loosely racemiform capitulescence with interspersed leaves only slightly reduced or not at all from the proximal cauline, different from the more densely congested, bracteate capitulescence of *S. concolor*. Turner (1982) treated the taxon as a synonym of *Aster concolor* L., and the type of *Aster lucayanum* Britt. (Britton & Millspaugh 2448, NY!) was annotated by W.T. Gillis in 1974 as *A. concolor*.

State-Rarity.—*Symphyotrichum sericeum* is currently ranked as S2 (Threatened or Rare) in Arkansas, Indiana, Michigan, and North Dakota (NatureServe 2008). It is listed as Nationally Threatened in Canada

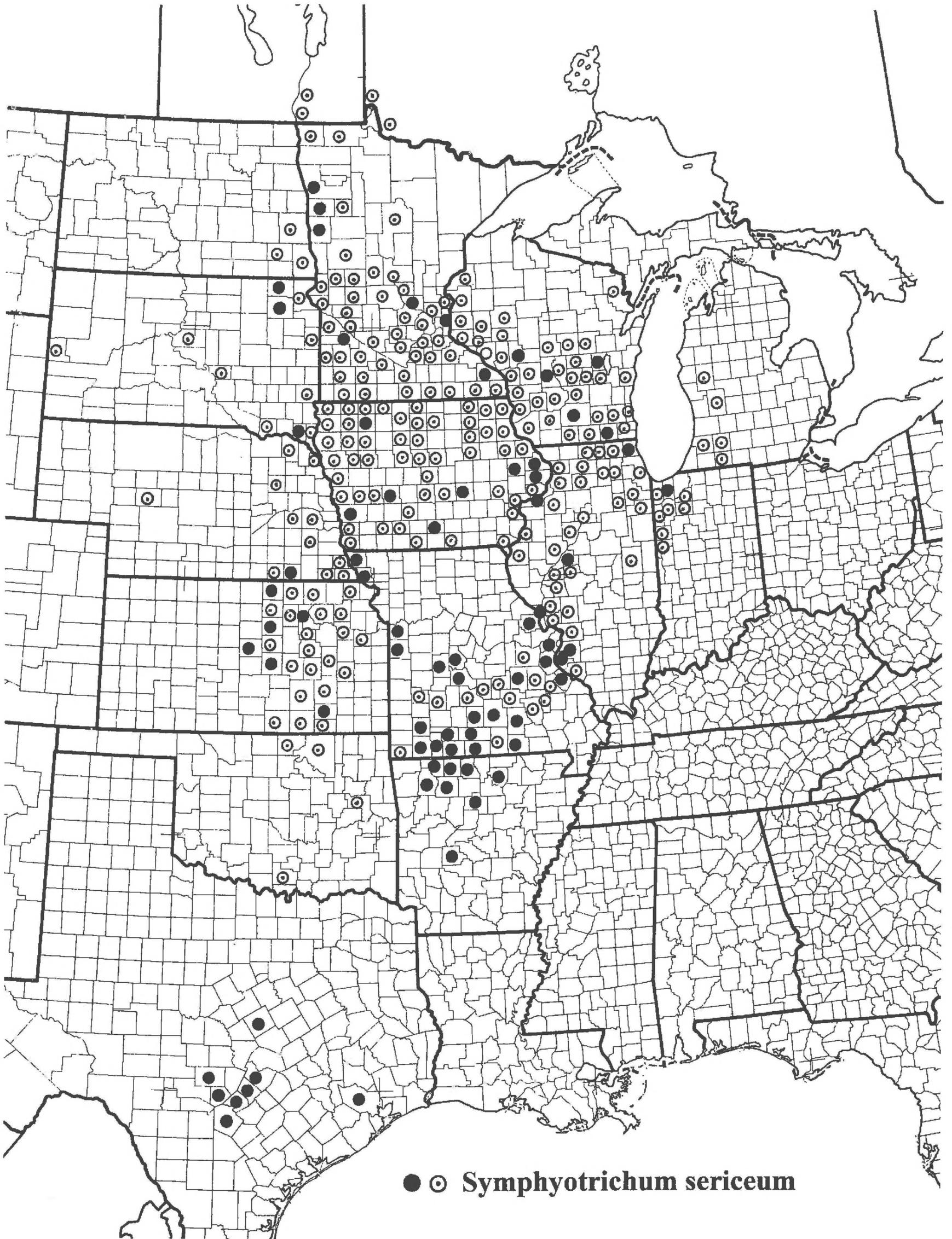


FIG. 1. Distribution of *Symphyotrichum sericeum*. Solid circles are from vouchered observations; dotted circles are from literature records.

(Foster & Hamel 2006). We could find no substantiation of the occurrence of *S. sericeum* in Georgia, Ohio, or Tennessee, where indicated to occur by Brouillet et al. (2006) and NatureServe (2008).

SYMPHYOTRICHUM PRATENSE

Distribution and Habitat.—The densest distribution of *Symphyotrichum pratense* is in Texas, Louisiana, and southern Arkansas—scattered, disjunct clusters of populations occur eastward over a wide geographic range and in a variety of physiographic provinces (Fig. 2). *Symphyotrichum pratense* in Texas characteristically occurs in sandy soil (sand, sandy loam, sandy clay, silty clay, silty clay-loam), being largely restricted to the following natural regions: Piney Woods, Oak Woods and Prairie, Gulf Coast Prairie and Marshes, and Blackland Prairie. Within these regions, it is less frequent in blackland prairie: e.g., **Texas. Dallas Co.:** Lundell 12032 (LL, SMU). Shinnery (1950), who recognized the legitimacy of the Rafinesque name ahead of the Torrey & Gray name, described this species as “a frequent and showy plant of open oak woods and transition-belt prairies throughout east Texas ...” In Texas, *S. pratense* also occurs in longleaf and loblolly pine areas and in coastal prairie grassland, and it has been collected from fields, roadsides, clearings, and fencerows.

In Louisiana the plants occur in pine flatwood sites, blackland prairie, chalk hills, and calcareous clays, as well as along dry roadsides. A blackland prairie locality for *Symphyotrichum pratense* is on the “Kieffer Prairie:” **Winn Par.:** Brown 8220 (SMU) and five other collections from the same locality (LSU Herbarium Online Database 2008). At the Kieffer Prairie *S. pratense* grows with associates such as *Schizachyrium scoparium*, *Andropogon gerardii*, *Sorghastrum nutans*, *Echinacea pallida*, *Oligoneuron rigidum*, and *Vernonia missurica* (USDA Forest Service 2008).

In the Gulf Coastal Plain of Arkansas, typical habitat for *Symphyotrichum pratense* is open saline barrens—treeless openings in *Pinus taeda/Quercus similis* flatwoods with clay soils containing high levels of sodium and/or magnesium. Eric Sundell, who first discovered the species in Arkansas at the Warren Prairie (Sundell 1983), noted that the plants occurred with prickly pear and dwarf palmetto and that a number of other rare species were associated with these sites, including *Geocarpon minimum* and *Schoenolirion wrightii*. The USDA Plants website (USDA, NRCS 2008) lists Izard and Newton counties in Arkansas for *S. pratense*, but these records from northern Arkansas are based on collections of *S. sericeum*.

Eastward (to Alabama, Florida, Georgia, Kentucky, Mississippi, Tennessee, and Virginia), *Symphyotrichum pratense* occurs mostly in calcareous habitats, e.g., chalk barrens, cedar glades, and limestone outcrops. Kral (1981) reported on the species at Coastal Plain sites in Alabama (Sumter Co.) and Florida (Gadsden Co.) and noted that the plants in Alabama were found in blackland prairie patches and that those in Florida were found at rocky calcareous outcrops in association with *Schoenus nigricans*, a plant more normally found near the coast. The species subsequently was discovered in Decatur Co., Georgia, just across the state line from Gadsden Co., in calcareous glades on a bluff: **Decatur Co.:** Godfrey & Gholson 80099 (GA). In Mississippi the species occurs in association with calcareous chalky outcrops (L. McCook, pers. comm.). The central Alabama and Mississippi populations are located in the Black Belt prairie lands (see Barone 2005). The most northerly populations in Alabama occur in limestone prairie barrens within the Highland Rim province, along with many other rare species, including *Dalea gattingeri*, *Leavenworthia alabamica*, *Cypripedium candidum*, *Eriogonum longifolium* var. *harperi*, *Schoenolirion croceum*, and *Spiranthes magnicamporum* (Webb et al. 1997).

At its most northerly range limits in Kentucky, *Symphyotrichum pratense* is found in glades or barrens habitats of the Interior Low Plateaus (chiefly Highland Rim sites) with *Juniperus virginiana* and *Quercus marilandica* as the woody dominants and with *Andropogon gerardii*, *Schizachyrium scoparium*, *Sorghastrum nutans*, *Sporobolus compositus*, and *S. vaginiflorus* as the conspicuous grasses. These habitats often contain a variety of other rare or infrequent plants, such as *Cypripedium candidum*, *Echinacea pallida*, *Liatris aspera*, *Liatris cylindracea*, *Lithospermum canescens*, *Silphium pinnatifidum*, *Dalea candida*, *Dalea purpurea*, and *Physostegia virginiana* (Cranfill 1991; Kentucky State Nature Preserves Commission 2008). The barrens sites in Tennessee (Highland Rim and Appalachian Plateau sites) and in southwestern Virginia (Valley and Ridge)

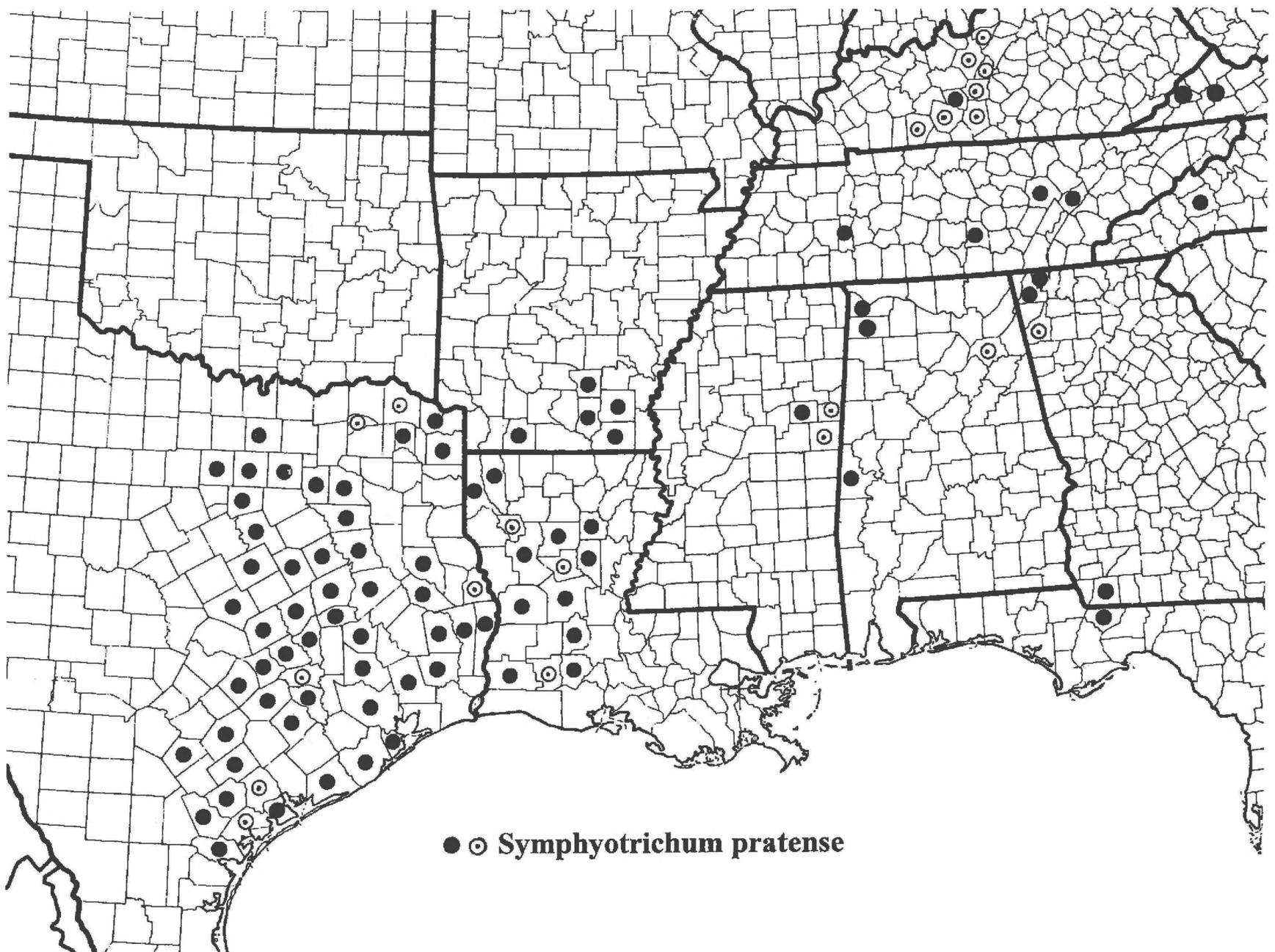


FIG. 2. Distribution of *Symphyotrichum pratense*. Solid circles are from vouchered observations; dotted circles are from literature records.

are very similar to the Kentucky sites and also contain a number of very rare species (DeSelm 1990; Ludwig 1999; Tennessee Natural Heritage Program 2008). In northern Georgia the plants occur at both Appalachian Plateau and at Valley and Ridge sites (T. Patrick, pers. comm.). In the Coosa river watershed of Georgia, *S. pratense* occurs in limestone glades; other species associated with this habitat include *Asclepias hirtella*, *Baptisia australis*, *Buchnera americana*, *Dalea gattingeri*, *Echinacea pallida*, *Hypericum dolabriforme*, *Hypericum sphaerocarpum*, *Liatris squarrosa*, and *Spiranthes magnicamporum* (Georgia Department of Natural Resources 2007).

Recent investigations of dolomite and limestone barrens in southwestern Virginia have discovered several populations of *Symphyotrichum pratense* -- initially reported by Ludwig (1999), subsequently treated by Brouillet et al. (2006), Weakley (2007), and Virginia Botanical Associates (2008). We have studied the following vouchers: **Russell Co.:** 1 km E of Carterton, one-acre barren at top of SW-facing slope on W end of a short ridge, dense grass cover with dolomitic limestone cobbles, 20 May 1996 [not yet in flower], *Wieboldt* 9415 (VPI); river knob 1 km E of Carterton, top of SW-facing hardwood slope, substrate cobbly with dolomitic (?) limestone, 2100 ft, dominant species with *Liatris aspera* and *Andropogon gerardii*, scattered over most of one-acre barren, 17 Sep 1996, *Wieboldt* 9605 (VDB, VPI); E side of Mill Creek where it cuts through ridge between Clinch River and Reeds Valley, ca. 1.9 km N of Jessees Mill, SW-facing limestone hillside in open grassland dominated by *Schizachyrium scoparium*, 2040 ft, ca. 20 plants, 11 Sep 1996, *Ludwig* 3082 (VPI). **Wise Co.:** *Fleming* 14122 (GMUF). Ludwig (1999) noted that this species has been found at six Russell County sites.

Chromosome Numbers.—The first report of the tetraploid level of $2n=20$ for *Symphyotrichum pratense* was from Gonzales Co., Texas, by Semple and Brouillet (1980), who noted that a diploid count had been made earlier for the species, but that report was unvouchered and part of a 1945 embryological study by German anatomists. Semple and Chmielewski (1987) published diploid counts for plants from Grimes and Walker counties in Texas and a tetraploid count for plants in Milam Co., Texas. Two years later Semple et al. (1989), reported a diploid count of $2n=10$ for plants from Gadsden Co., Florida. In addition, we report a previously unpublished $2n=20$ count for *S. pratense*: **Kentucky. Hardin Co.:** cedar glade off KY 2762, 6 Nov 1987, R.L. Jones 5457 (EKY).

Taxonomy.—In the main part of the range of *Symphyotrichum pratense*, the plants typically have phyllary surfaces mostly glabrous and strongly contrasting with the spreading-ciliate margins. Phyllaries of the Virginia plants are unusual, having densely sericeous surfaces, with or without strongly ciliate margins, but resemble typical *S. pratense* of Texas and Louisiana in the proximal indurate portion of the phyllary being relatively short, the distal leafy portion being relatively broad and long, and the overall phyllary length about 1.5 cm. Their geographic position also obviously suggests that they are part of *S. pratense*. Some plants from Tennessee are similar in their phyllary features (e.g., **Roane Co.:** Morton 1307, SMU).

The description of *Aster montanus* Nutt. seems to refer to *Symphyotrichum pratense*; Nuttall noted that it was “nearly allied to the preceding [*Aster sericeus*], but distinct.” Torrey and Gray (in Fl. N. Amer.) treated it as *A. sericeus* var. β . They also noted that the species was known from “Tennessee and North Carolina near the mountains.” On Nuttall’s 1816 trip, he crossed from Tennessee to Asheville, N.C., and went on to Rutherfordton and Morganton (Graustein 1967). Gray (in Synop. Fl. N. Amer.) formalized the name at varietal rank, as *Aster sericeus* var. *montanus* (Nutt.) Gray, noting that the involucre is “sometimes glabrate and villose-ciliate; approaching the next species [*A. phyllolepis*].” An image of the holotype of *A. montanus* was obtained from PH, and an examination indicates that the involucral widths are about 2 cm wide, much larger than typical *S. sericeum*, and we therefore place this name in the synonymy of *S. pratense*.

Today neither *S. sericeum* nor *S. pratense* is known to occur in North Carolina. Gray (in Fl. N. Amer.) listed North Carolina as included in the range of *A. sericeus* var. β , and later (in Synop. Fl. N. Amer.), he specified Buncombe County as the site of the collection. The specimen upon which Gray apparently based his comment was located at NY, and an image was obtained. The sheet bears three plants from two different areas—two are from Minnesota and identified as *Aster sericeus*, while the other was collected from “Buncombe, North Carolina, Gibbes” and identified as “*A. sericeus* β . (*montanus* Nutt.)” This latter specimen exhibits the large heads of *S. pratense*, and is here assigned to that taxon; it represents the only known record of the species from North Carolina. *S. pratense* has not been subsequently rediscovered in the state and can be assumed to be extirpated there.

Aster montanus Nutt., Gen. N. Amer. Pl. 2:156. 1818 (non *A. montanus* All. 1785). *Aster sericeus* var. *montanus* (Nutt.) A. Gray, Synopt. Fl. N. Amer. 1, part 2:179. 1884. *Lasallea nuttallii* Greene [nom. nov.], Leaflet Bot. Observ. Crit. 1:5. 1903. USA. Tennessee. No other collection data, [T. Nuttall s.n., September to early October 1816, fide Graustein 1967], annotated in Nuttall’s handwriting as “*Aster montanus*” (HOLOTYPE: PH, digital image!). Nuttall’s protologue: “HAB. On the mountains of Tennessee and North Carolina, rare. (Near Asheville and Morganton).”

When these disjunct populations of *Symphyotrichum pratense* were first discovered in eastern U.S., especially at the more northerly sites in Alabama, Tennessee, and Kentucky, they were often identified as *S. sericeum*. They are still listed as such in several state natural heritage databases. We now confirm all examined specimens from Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, Tennessee, and Virginia as *S. pratense*.

State-Rarity.—*Symphyotrichum pratense* is generally rare outside its main range in Texas and Louisiana—it is currently considered Threatened (S2) in Arkansas, Special Concern (S3) in Kentucky, and S1 (critically imperiled) in Alabama, Georgia, Mississippi, Tennessee, and Virginia (NatureServe 2008). Although there is only one known county of occurrence in Florida (the only state where it still is treated as a variety of *S. sericeum*, *S. pratense* is currently not listed among that state’s rare species (Florida Natural Areas Inventory 2008).

Morphological Criteria for Distinguishing the Taxa.—Our examination of specimens from throughout much of the ranges of the two taxa indicates that they can be reliably distinguished as follows:

1. Phyllaries densely sericeous, vestiture of margins similar to surfaces, not spreading ciliate; terminal, green, pubescent portion of largest phyllaries $1/4$ – $1/3$ (– $1/2$) the total phyllary length, usually distinctly shorter than the proximal, indurate and glabrate portion; middle phyllaries mostly ≤ 7 mm long and ≤ 2 mm wide, averaging 6 (–8) mm long and 2 (–3) mm wide; involucre height mostly < 10 mm (7–11 mm) high

Symphyotrichum sericeum

1. Phyllaries with abaxial faces usually glabrous to glabrate, less commonly sparsely strigose sericeous (rarely densely sericeous), margins ciliate with thick-based, spreading hairs 0.5–1.0 mm long, much longer than those on the surfaces; terminal, green, pubescent portion of largest phyllaries $2/3$ – $3/4$ the total phyllary length, longer than the proximal, indurate and glabrate portion; middle phyllaries mostly ≥ 8 mm long and ≥ 2.5 mm wide, averaging 9 (–14) mm long, and 3 (–5) mm wide; involucre height mostly ≥ 10 mm (8–15 mm) high

Symphyotrichum pratense

CONCLUSION

Symphyotrichum pratense and *S. sericeum* are distinct species of central and eastern U.S. They are largely allopatric in distribution, and occur sympatrically only in Texas, where *S. pratense* is common and *S. sericeum* rare. *Symphyotrichum pratense* is associated with a range of physiographic provinces—it is chiefly Coastal Plain in distribution, but its range extends to the Interior Low Plateaus, the Appalachian Plateau, and the Valley and Ridge. There is an historical record from the Blue Ridge of North Carolina. *Symphyotrichum sericeum* is largely associated with the Central Lowlands Province and the Ozark Plateau, and only sporadically into adjacent provinces to the south, north, and west. Disjunct populations and population systems are a prominent feature of the biology of both taxa. There is some intermediacy in phyllary pubescence in the easternmost disjunct populations, but these features could be interpreted as resulting from local genetic drift in populations far removed from the main range of the species, and there is no evidence of any significant gene interchange between the taxa. The available evidence indicates that *S. sericeum* consists of diploid populations (with the exception of one anomalous report) and that *S. pratense* contains populations at both ploidy levels. *Symphyotrichum sericeum* is generally common throughout much of its range, considered rare only in the states at the eastern and southern periphery of its range (Michigan, Indiana, and Arkansas), and is Nationally Threatened in Canada. Outside of Texas and Louisiana, *S. pratense* is a rare plant and is considered critically imperiled in several states (Alabama, Georgia, Mississippi, Tennessee, and Virginia). The identity of these disjunct eastern populations has been the source of some confusion in the past — they have been variously treated by the different states as *S. pratense* or *S. sericeum*, and this latter name continues to be used by some eastern states for their rare species lists. Our study concludes that all specimens examined from populations in Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, Tennessee, and Virginia, are *S. pratense*.

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REFERENCES

- BARONE, J.A. 2005. Historical presence and distribution of prairies in the Black Belt of Mississippi and Alabama. *Castanea* 70:170–183.
- BROUILLET, L., J.C. SEMPLE, G.A. ALLEN, K.L. CHAMBERS, and S.D. SUNDBERG. 2006. *Symphyotrichum*. In: Flora of North America Editorial Committee, eds. 1993+. Flora of North America North of Mexico. 12+ vols. Oxford Univ. Press, New York and Oxford. Vol. 20:465–539.
- COCHRANE, T.S. and H.H. ILLIS. 2000. Atlas of the Wisconsin prairie and savanna flora. Tech. Bull. No. 191. Wisconsin Department of Natural Resources and the University of Wisconsin-Madison Herbarium, Madison.
- CORRELL, D.S. and M.C. JOHNSTON. 1970. Manual of the vascular plants of Texas. Texas Research Foundation, Renner, Texas.
- CRANFILL, R. 1991. Flora of Hardin County, Kentucky. *Castanea* 6:228–267.
- CRONQUIST, A. 1980. Flora of the Southeastern United States. Vol. 1. Asteraceae. Univ. of North Carolina Press, Chapel Hill.
- DESELM, H.R. 1990. Flora and vegetation of some barrens of the eastern Highland Rim of Tennessee. *Castanea* 55:187–206.
- FLORIDA NATURAL AREAS INVENTORY. 2008. Field guide to the rare plants and animals of Florida. <<http://www.fnai.org/fieldguide/>> Accessed March 2008.
- FOSTER, C. & C. HAMEL. 2006. Rare species surveys of the Manitoba Conservation Data Centre, 2005. MS Report 06-01. Manitoba Conservation Data Centre, Winnipeg. <http://web2.gov.mb.ca/conservation/cdc/requests/pdf/rare-species_survey_2005.pdf> Accessed March 2008.
- GEORGIA DEPARTMENT OF NATURAL RESOURCES. 2007. Wildlife Resources Division. Known occurrences of Special Concern plants, animals, and natural communities of the Coosa River Watershed. <georgiawildlife.dnr.state.ga.us/assets/documents/HUC8_03150105.rtf> Accessed March 2008.
- GRAUSTEIN, J.E. 1967. Thomas Nuttall, naturalist: Explorations in America, 1808-1841. Harvard University Press, Cambridge.
- JONES A.G. 1980. Data on chromosome numbers in *Aster* (Asteraceae), with comments on the status and relationships of certain North American species. *Brittonia* 32:240–261.
- JONES, R.L. 1990. The taxonomy and distribution of *Aster pratensis* Raf. *ASB Bull.* 37:99 (Abstract).
- KRAL, R. 1981. Further additions to some notes on the flora of the southern states, particularly Alabama and middle Tennessee. *Rhodora* 83:301–315.
- KENTUCKY STATE NATURE PRESERVES COMMISSION. 2008. Kentucky Rare Plant Database. <<http://epccapps.ky.gov/nprare-plants/index.aspx>> Accessed March 2008.
- LOUISIANA STATE UNIVERSITY HERBARIUM ON-LINE DATABASE. 2008. Dept. of Biological Sciences, LSU, Baton Rouge. <<http://www.herbarium.lsu.edu>> Accessed January 2008.
- LÖVE, Á. (ed.). 1982. IOPB chromosome number reports LXXV. *Taxon* 31:342–368 (count on page 359 under *Virgulus sericeus*).
- LUDWIG, J.C. 1999. The flora of dolomite and limestone barrens in southwestern Virginia. *Castanea* 64:209–230.
- NATURESERVE 2008. NatureServe Explorer: an online encyclopedia of life (web application). Version 7.0. NatureServe, Arlington, Virginia. <http://natureserve.org/explorer>. (Accessed April 2008).
- NESOM, G.L. 1994. Taxonomic overview of *Aster sensu lato* (Asteraceae: Astereae), emphasizing the New World species. *Phytologia* 77:141–297.
- SEMPLÉ, J.C. and L. BROUILLET. 1980. Chromosome numbers and satellite chromosome morphology in *Aster* and *Lasallea*. *Amer. J. Bot.* 67:1027–1039.
- SEMPLÉ, J.C. and J.G. CHMIELEWSKI. 1987. Chromosome numbers in Fam. Compositae, Tribe Astereae. II. Additional Counts. *Rhodora* 89:319–325.
- SEMPLÉ, J.C., J.G. CHMIELEWSKI, and M. LANE. 1989. Chromosome numbers in Fam. Compositae, Tribe Astereae. III. Additional counts and comments on some generic limits and ancestral base numbers. *Rhodora* 91:296–314.

- SEMPLE, J.C., S.B. HEARD and L. BROUILLET. 2002. Cultivated and native asters of Ontario (Compositae: Astereae): *Aster* L. (including *Asteromoea* Blume, *Diplactis* Raf. and *Kalimeris* (Cass.) Cass.), *Callistephus* Cass., *Galatella* Cass., *Doellingeria* Nees, *Oclemena* E.L. Greene, *Eurybia* (Cass.) S.F. Gray, *Canadanthus* Nesom, and *Symphyotrichum* Nees (including *Virgulus* Raf.). Univ. Waterloo. Biol. Ser. No. 41:1–134.
- SHERIF, A.S., E.B. SMITH, and K.L. HORNBERGER. 1983. In IOPB Chromosome Number Reports LXXX. *Taxon* 32:508.
- SHINNERS, L.H. 1950. Notes on Texas Compositae—V. *Field & Lab.* 18:32–42.
- SUNDELL, E. 1983. Two additions to the Arkansas flora from Warren Prairie. *Sida* 10:188–189.
- SWINK, F. and G. WILHELM. 1994. *Plants of the Chicago Region*. Indiana Academy of Science, Indianapolis.
- TENNESSEE NATURAL HERITAGE PROGRAM. 2008a. Natural Heritage Inventory Program. <<http://www.tennessee.gov/environment/na/nhp.shtml>>. Accessed March 2008.
- TURNER, B.L. 1982. Asteraceae. In: Correll, D.S. and H.B. Correll. *Flora of the Bahama Archipelago*. J. Cramer, Valduz. Pp. 1438–1553.
- USDA FOREST SERVICE. 2008. Celebrating wildflowers. <<http://www.fs.fed.us/wildflowers/regions/southern/Keiffer-Prairies/index.shtml>> Accessed March 2008.
- USDA, NRCS. 2008. The PLANTS Database, National Plant Data Center, Baton Rouge, LA. <<http://plants.usda.gov>> Accessed March 2008
- VIRGINIA BOTANICAL ASSOCIATES. 2008. Digital Atlas of the Virginia Flora. <http://www.biol.vt.edu/digital_atlas/index.php?do=start> Accessed January 2008.
- WEAKLEY, A.S. 2007. *Flora of the Carolinas, Virginia, Georgia, and surrounding areas*. Working Draft of 11 January 2007. Univ. of North Carolina Herbarium (NCU). <<http://www.herbarium.unc.edu/WeakleysFlora.pdf>> Accessed January 2008.
- WEBB, D.H., H.R. DESELM, and W.M. DENNIS. 1997. Studies of prairie barrens of northwestern Alabama. *Castanea* 62:173–184.
- WUNDERLIN, R.P. and B.F. HANSEN. 2004. *Atlas of Florida Vascular Plants* [S.M. Landry and K.N. Campbell (application development), Florida Center for Community Design and Research.] Institute for Systematic Botany, University of South Florida, Tampa. <<http://www.plantatlas.usf.edu/>> Last modified 11 July 2007. Accessed January 2008.